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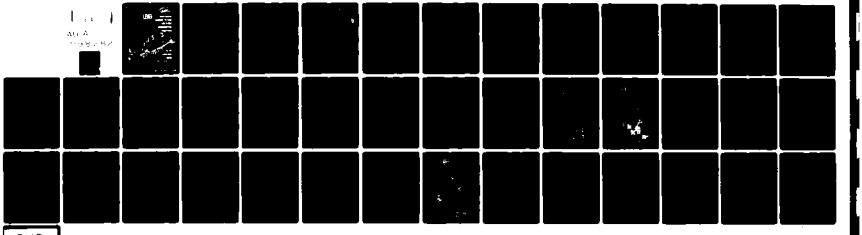

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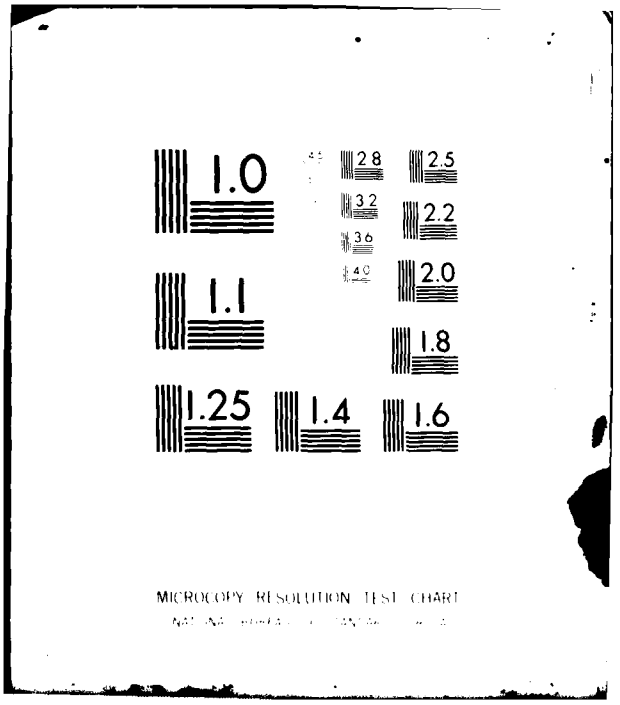
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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The primary objective of this study is to identify baseline data on the degree of adoption of conservation practices, particularly reduced tillage practices, in the Lake Erie Basin. A second objective is to identify some factors which explain the adoption of reduced tillage and other conservation practices. A third objective is to identify education and technical assistance programs within the Basin.

Two surveys were conducted in order to meet these objectives. The first

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used a mail questionnaire sent to a random sample of 5 percent of the Basin's farmers. The second survey identified education and technical assistance programs in the Basin. A complete enumeration was made by contacting county Cooperative Extension Service or Soil Conservation Service Personnel.

Results show that minimum tillage is being used on 21 percent of row crop acreage. No tillage is being used on about 2 percent of the row crop acreage. Those farmers with large row crop acreages tend to have high reduced tillage adoption rates. Also, better educated farmers tend to have high reduced tillage adoption rates. Conservation practices which are used widely in the Basin include grassed waterways, winter cover crops, and crop rotations. Twenty seven county education and technical assistance programs are in progress throughout the Basin. The cropland in tillage demonstration programs totals over 4,400 acres. Many of these programs are highly visible, but it is likely that several years are needed before these programs affect reduced tillage adoption rates.

Adoption of Reduced Tillage and Other Conservation Practices in the Lake Erie Basin

by

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Prepared for:
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ABSTRACT

The primary objective of this study is to identify baseline data on the degree of adoption of conservation practices, particularly reduced tillage practices, in the Lake Erie Basin. A second objective is to identify some factors which explain the adoption of reduced tillage and other conservation practices. A third objective is to identify education and technical assistance programs within the Basin.

Two surveys were conducted in order to meet these objectives. The first used a mail questionnaire sent to a random sample of 5 percent of the Basin's farmers. The second survey identified education and technical assistance programs in the Basin. A complete enumeration was made by contacting county Cooperative Extension Service or Soil Conservation Service Personnel.

Results show that minimum tillage is being used on 21 percent of row crop acreage. No tillage is being used on about 2 percent of the row crop acreage. Those farmers with large row crop acreages tend to have high reduced tillage adoption rates. Also, better educated farmers tend to have high reduced tillage adoption rates. Conservation practices which are used widely in the Basin include grassed waterways, winter cover crops, and crop rotations. Twenty seven county education and technical assistance programs are in progress throughout the Basin. The cropland in tillage demonstration programs totals over 4,400 acres. Many of these programs are highly visible, but it is likely that several years are needed before these programs affect reduced tillage adoption rates.

Introduction

Development of a wastewater management program for the restoration and rehabilitation of Lake Erie is the task of the Lake Erie Wastewater Management Study, Corps of Engineers. The Corps has recommended an accelerated education and technical assistance program as a method of controlling diffuse source pollution in Lake Erie. This recommendation rests on the assumption that farmers are presently using conventional tillage practices on most of the cropland that is economically suitable for reduced tillage practices. An accelerated education and technical assistance program would speed up the process of adopting reduced tillage and other conservation practices in areas thought suitable for these practices.

Prior to planning and implementing such an education and technical assistance program, it is essential that the participating agencies have knowledge of the extent to which conservation practices are being used. Also, it is necessary to establish baseline information in order to determine the change in the use of farm practices in the coming years. Hence, the primary objective of this study is to provide baseline data on the degree of adoption of conservation practices, particularly reduced tillage practices. A second objective is to identify some factors which appear to explain the adoption of reduced tillage and other conservation practices. A number of factors thought to affect the adoption of these practices are identified, and the importance of each of the factors is estimated. A third objective is to identify education and technical assistance programs within the Basin.

Procedure

The procedure adopted for this research provided for gathering the largest amount of information on the adoption of reduced tillage and conservation practices across the Lake Erie Basin at the least expense. The size of the Basin (11.6 million acres in 60 counties across five states) and budget constraints mandated a mail questionnaire sent to a random sample of farmers as the method of data collection for the study's first two objectives.

The questionnaire was designed with assistance of individuals from the Soil Conservation Service, The Ohio State University, and the Corps of Engineers. The basic criteria for the questionnaire design was that it provide information on adoption rates from as large a proportion of the sample as possible. Since those receiving the questionnaire were asked to voluntarily complete and return it, an attempt was made to keep the questionnaire concise so that a respondent could complete it within a few minutes. The initial questionnaire was pretested with a few farmers and modified to reflect their comments. A sample questionnaire is attached (Appendix A).

In addition to questions concerning the adoption of alternative tillage and other conservation practices, questions were asked about (a) reasons for adopting or not adopting reduced tillage, (b) the extent of improved drainage and needed additions to improved drainage systems, (c) characteristics of the farmer such as tenure, age, education, primary occupation, gross income, and acres farmed, and (d) attitudes concerning environmental impr vement, the respondents' political

orientation (liberal vs. conservative) and their orientation toward agriculture (agrarian vs. cosmopolitan).

The population for the sample was ideally all farm operators in the Basin. It was thought that lists of farmers in each county office of the Agricultural Stabilization and Conservation Service (ASCS), U.S. Department of Agriculture would best represent this population. These lists have been updated periodically by county ASCS officials and were thought to be the most complete source of farmers names and addresses. Other lists of farmer names might have been used and were considered as sources for the sample. These potential sources included county Cooperative Extension Service mailing lists and Soil & Water Conservation District cooperators; however, it was felt that potential bias would have existed if these lists had been used.

Each state executive director of ASCS asked ASCS county offices located in the Lake Erie Basin to draw a five percent, random sample of farmers in the county. All county ASCS offices promptly completed this task and forwarded the sample to the state ASCS offices. The total sample from the five states numbered nearly 5100 farmers. These names were stored in a computer to assist in the mailing of questionnaires and survey results.

Each farmer in the sample was mailed the questionnaire in late August, 1979. Farmers were asked to return the questionnaire within two weeks. In mid-September, a second questionnaire was sent and farmers were asked to complete the second questionnaire if they had not returned the first one. Over 1100 questionnaires were returned. In addition, over 100 notices were received

indicating that the respondent was deceased or no longer farmed. Of these 1200 responses (24 percent of the questionnaires mailed), 934 completed the questionnaire and were included in the analysis.

A separate survey was conducted to provide data for the third objective, identifying existing education - technical assistance programs in the Basin. The intent of this survey was to get an indication of the extent of reduced tillage field plot and demonstration programs being conducted within the Basin. Questionnaires were mailed to the Cooperative Extension Service County Agent or the Soil Conservation Service District Conservationist in each county. Of the 62 counties in the Basin, information was gained on the education - technical assistance program in 57 counties (Appendix B).

Farmer Characteristics and Adoption Rates in the Basin

It is felt that the response rate is sufficient to yield reliable results for the Basin as a whole. These results are discussed first. Next, county estimates are made for adoption rates of reduced tillage technologies. These county estimates are somewhat tenuous given the limited number of responses in some counties. Generally, it is felt that these estimates are reliable in counties with large row crop acreage. In these counties the response rate is sufficient so that there are at least 10 observations and as many as 55 observations per county. However, in counties with relatively small row crop acreage or counties on the fringe of the Basin, county

estimates must be interpreted with caution due to the limited number of observations.

Survey respondents' characteristics are shown in Table 1. On the average, they are about 48 years of age, have completed high school, have been farming most of their lives, and consider farming to be their primary occupation. They farm nearly 350 tillage acres, of which about half is owned and the other half is rented. Over sixty percent of the tillable acres were in corn and soybeans in 1979.

These results indicate that the respondents represent the larger farmers in the Basin. The amount of cropland in the Basin totals about 100 acres per farm.[1] However, respondents' tillable acres per farm are about 350. It is expected that a relatively larger proportion of full-time farmers returned completed questionnaires than did part-time farmers. Also, it is expected that the response rate was low from those with a relatively small farm operation, not having intensive row crop production, and/or not viewing soil conservation as a problem on their farm.

Since those returning completed questionnaires tend to have a relatively large number of tillable acres, the total amount of cropland in the Basin represented by the results is relatively large. Respondents farm over 4 percent of the Basin's cropland although they comprise only about 1 percent of the Basin's farmers.

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[1]The Land Resources Information System estimates total cropland area to be about 8.37 million acres in the Basin. ASCS county lists contain the names of about 100,000 farmers in the Basin.

Table 1. Characteristics of Lake Erie Basin Survey Respondents, 1979.

Characteristic	Mean	Standard Deviation
Age (yrs)	48.3	14.5
Education (yrs)	12.4	2.1
Gross farm income (1979 $)	44,600	39,000
Proportion considering farming to be primary occupation (%)	69	
Years associated with farming	33.4	17.0
Tillable acres owned or farmed		
- Owned and Operated	165	
- Rented from others	182	
- Owned and rented to others	21	
TOTAL	368	474
Row crop acres farmed	226	306

Table 2. Adoption Rates of Alternative Tillage Systems for Lake Erie Basin Survey Respondents, 1979.

Practice[a/]	Proportion of Row Crop Acres%
Conventional tillage	
- Fall plow	42.2
- Spring plow	34.6
Minimum tillage	21.2
No till	1.7

[a/] Conventional tillage uses traditional moldboard plowing. Minimum tillage replaces moldboard plowing with chisel plowing, disking, field cultivating or similar minimum tillage practices. With no tillage, weed control is accomplished with chemicals, and the soil is not tilled. Reduced tillage refers to either minimum tillage or no tillage.

Conventional tillage is being used on most of the respondents' crop acreage in the Basin. Fall plowing is being used on about 42 percent and spring plowing on about 35 percent of the row crop acreage. Reduced tillage systems are being employed on 23 percent of the row crop acreage, with minimum tillage systems being the predominant form of reduced tillage (Table 2).

Respondents' reasons for adopting reduced tillage systems agree with the notions that reduced tillage systems are cost reducing and soil conserving. Respondents' rankings of reasons for adopting reduced tillage are - first, reduced fuel costs; second, conservation of soil productivity; third, reduced labor costs, fourth, reduced equipment costs; fifth, increased yields, and finally, reduced water pollution. Those who have not adopted reduced tillage systems identify weed control problems, inappropriate soils, poor stands, and higher equipment costs as being leading factors against reduced tillage (Table 3).

Respondents were asked to check conservation practices, other than reduced tillage, used on farmland that they owned or rented. Results measure only the proportion of farmers using each conservation practice. The extent of each practice, such as the number of grass waterways or diversions, is unavailable. Grass waterways, winter cover crops, and crop rotations are the predominant conservation practices being used (Table 4). About one-fourth of the farmers checked these practices as being used. Drop structures and rock shutes are used by about 10 percent of the farmers, and diversions are used by about 8 percent. Practices

Table 3. Reasons Given by Lake Erie Basin Survey Respondents for Adopting and Failing to Adopt Reduced Tillage Systems, 1979.

Reasons	Number of Responses	Mean Score (Scale: 1 to 5 where 1 is completely unimportant and 5 is very important)
Reasons for adopting reduced tillage		
1. Reduced fuel costs	464	4.37
2. Conserve soil productivity	439	4.18
3. Reduced labor cost	455	4.00
4. Reduced equipment costs	437	3.87
5. Increased yields	427	3.79
6. Reduced water pollution	435	3.61
Reasons for failing to adopt reduced tillage		
1. Weed control problems	392	4.14
2. Soil not conducive	375	3.89
3. Poor stands	342	3.86
4. Increased equipment costs	355	3.68
5. Pest control problems	334	3.34
6. Increased fuel costs	326	3.27
7. Increased labor costs	321	2.93

Table 4. Proportion of Lake Erie Basin Survey Respondents Using Selected Conservation Practices, 1979.

Practice	% of Farms
Grassed waterways	29.8
Winter cover crop	25.3
Crop rotations	
- rotations with meadow	26.0
- rotations without meadow	24.2
Drop structures/rock shutes	9.9
Diversions	7.8
Filter strip	4.9
Strip cropping	4.4
Contour farming	2.4
Terracing	1.7

such as filter strips, strip cropping, contour farming, and terracing are used on only a small proportion of Basin farms.

Each farmer was asked to respond to statements which pertained to efforts to enhance the environment, their political orientation, and their agrarian orientation. Some opinions on efforts to enhance the environment are the following:

	Statement	Mean response Scale: 1 to 5, 1 means item definitely should be done or strong agreement, 5 means item definitely should not be done or strong disagreement
a.	Preserve land for food production	1.44
b.	Reduce soil erosion on farms	1.60
c.	Reduce water pollution from farms	2.56
d.	Industry should be allowed to handle pollution its own way	3.82

These responses indicate that Lake Erie Basin farmers are in favor of environmental improvement in general. However, responses to the following statements indicate that they dislike the use of government intervention in order to achieve these improvements.

	Statement	Mean response Scale: 1 to 5, 1 means item definitely should be done or strong agreement, 5 means item definitely should not be done or strong disagreement
a.	More government control of runoff from cropland and confined livestock facilities	3.49
b.	Pollution laws have gotten too strict in recent years	2.36

The political orientation of the surveyed farmers leans toward being conservative. They describe themselves as being midway between moderate and conservative in their orientation, and they are in favor of less government regulation. Their favorable response to enhancement of the environment and their conservative political philosophy seem somewhat paradoxical. They want to preserve agricultural land, reduce soil erosion, and improve water quality, but they have a dislike for government controls or regulations.

Their outlook tends to be agrarian in orientation. That is, rural life is preferred to city life, children are thought better raised in the country, and the family farm is thought vital to the American way of life. This high agrarian orientation is demonstrated by the following responses:

Statement	Mean response Scale: 1 to 5, 1 means item definitely should be done or strong agreement, 5 means items definitely should not be done or strong disagreement.
a. The family farm should be preserved	1.39
b. The farm is an ideal place to raise a family	1.42
c. The family farm is vital to maintaining the American way of life	1.54
d. City life is too rushed and formal	1.93
e. Agricultural life is the natural life for man	2.01
f. Children should spend at least part of their childhood on a farm	2.03

County Estimates of Adoption Rates

County estimates are rather tentative due to the small number of observation in some counties. But county estimates do provide a first approximation of farm characteristics and tillage practices for farms having row crops. Table 5 provides information on the number of observations for each county and respondents' mean tillable acres, tenure on these acres, and acres of row crops by county.

The mean number of tillable acres operated by respondents in the Basin is 347. Of these tillable acres, 227, or 65 percent, are in row crops. Both the number of tillable acres per farm and the proportion of these acres in row crops vary widely over the Basin. Figures 1 and 2 depict the variability in the mean tillable acreage per farm and the intensity of cropping. Basin farms in northwestern Ohio, Indiana, and southeastern Michigan tend to have larger tillable acres and have a higher proportion of these acres in row crops. Those Basin farms located in New York, Pennsylvania, eastern Ohio, and the upper reaches of the Basin in Michigan tend to have fewer tillable acres and farm these acres less intensively. These observations are consistent with the land use information in the Land Resources Information System (LRIS) reported in the LEWMS Methodology Report.

Table 5. Lake Erie Basin Survey--Characteristics of Respondent's Farms by County, 1979.

	Number of Observations	Tillable Acres				Acres of Row Crops
		Owned and Operated	Owned and Rented to Other to Operate	Rented from Others and Operated	Total	
Monroe, MI	29	134	15	180	329	215
Crawford, OH	18	142	0	90	233	153
Seneca, OH	22	163	15	165	343	219
Huron, OH	29	274	34	252	560	406
Ottawa, OH	27	121	14	224	360	244
Sandusky, OH	30	166	6	113	285	217
Erie, OH	17	287	12	161	460	329
Wood, OH	55	167	7	296	470	351
Lucas, OH	12	78	3	89	170	116
Hancock, OH	27	301	12	273	586	383
Wyandot, OH	16	278	0	272	550	357
Hardin, OH[a]	2					
Marion, OH[a]	0					
Richland, OH[a]	0					
Henry, OH	37	223	2	281	506	355
Ashland, OH[a]	1					
Medina, OH	23	70	2	80	152	81
Cuyahoga, OH[a]	0					
Summit, OH[a]	2					
Lake, OH	5	61	0	72	132	19
Geauga, OH	8	47	13	1	61	11
Portage, OH	9	168	11	25	204	69
Stark, OH[a]	3					
Ashtabula, OH	13	83	19	38	141	45
Trumbull, OH[a]	0					
Erie, PA	20	145	7	86	237	80
Crawford, PA	7	84	23	6	112	15
Chautauqua, NY	14	91	9	39	139	23
Erie, NY	9	109	47	58	213	68
Cattaraugus, NY	12	180	0	104	284	51
Wyoming, NY	7	316	21	48	386	179
Sanilac, MI	11	165	60	202	427	127
Lapeer, MI	13	121	11	98	229	82
St. Clair, MI	26	183	24	303	510	316
Ingham, MI[a]	1					
Livingston, MI[a]	1					
Oakland, MI	7	40	0	139	178	75
McComb, MI	11	47	0	225	272	125
Jackson, MI[a]	0					
Washtenaw, MI	21	134	24	65	223	102
Wayne, MI	10	107	4	155	266	202
Hillsdale, MI	12	109	19	27	155	89
Lenawee, MI	32	245	2	214	461	310
Steuben, IN[a]	0					
Williams, OH	12	122	0	194	316	203
Fulton, OH	13	305	8	139	452	277
Noble, IN	5	236	0	101	337	228
DeKalb, IN	17	195	0	235	430	284
Defiance, OH	25	151	14	210	374	247
Lorain, OH	35	152	20	117	289	176
Allen, IN	19	133	4	193	329	199
Paulding, OH	36	150	61	246	456	270
Putnam, OH	22	149	0	176	325	201
Wells, IN[a]	0					
Adams, IN[a]	1					
VanWert, OH	38	180	0	395	576	423
Allen, OH	24	263	15	215	493	326
Mercer, OH	20	131	17	147	294	211
Auglaize, OH	11	126	12	117	255	168
Shelby, OH[a]	0					
Allegheny, NY[a]	1					
Genesee, NY[a]	2					
Unidentified	58	120	16	124	260	148
Lake Erie Basin	934	165	21	182	368	227

[a]Counties with less than 5 observations are not summarized.

Figure 1. Lake Erie Basin Survey -
Respondents' Row Crop Acreage per Farm, by County, 1979.

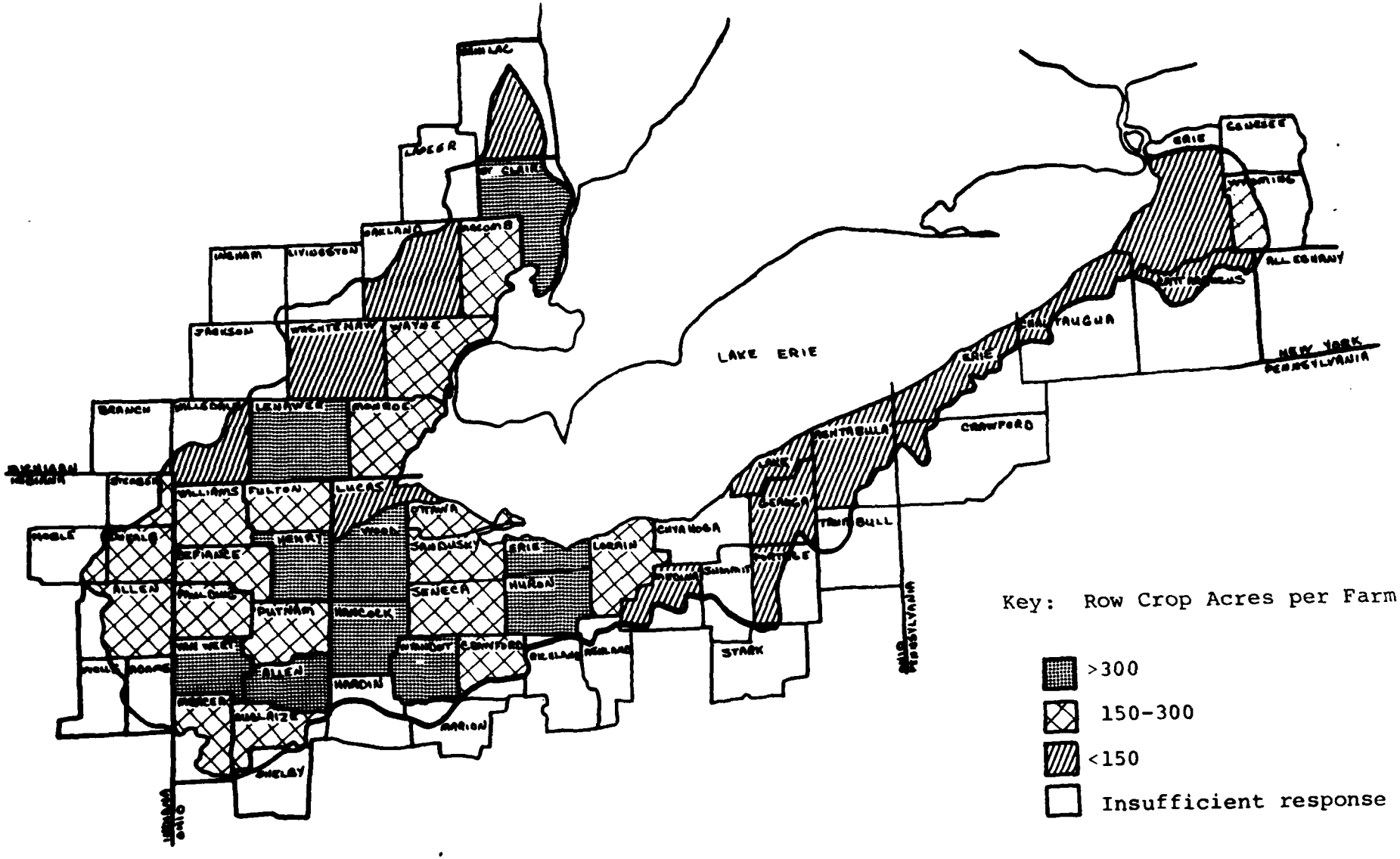
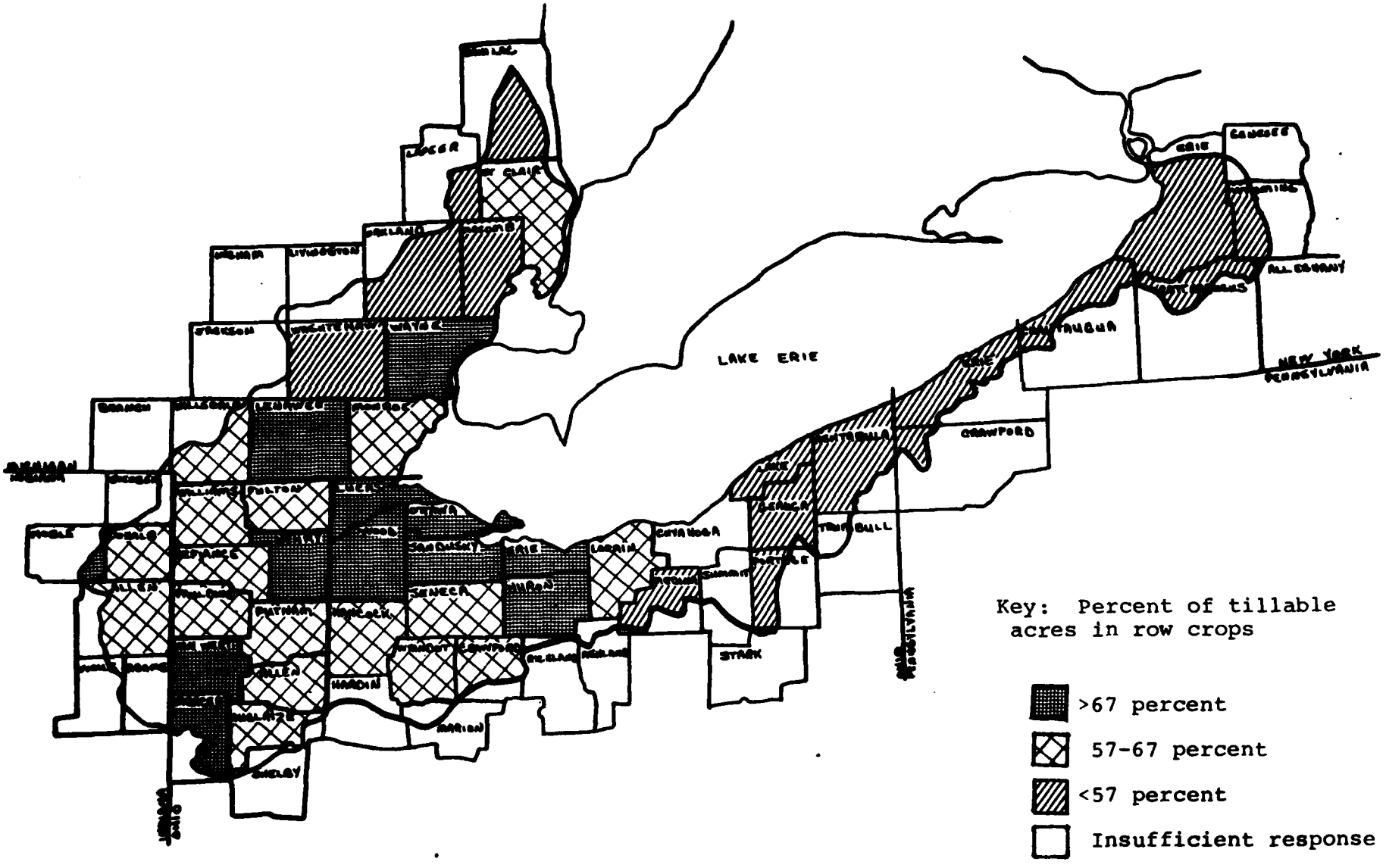


Figure 2. Lake Erie Basin Survey -
Proportion of Tillable Acreage in Row Crops on Respondents' Farms, by County, 1979.



Adoption of reduced tillage practices has occurred on 23 percent of the Basin's row crop acreage according to survey participants. There seems to be little pattern to this adoption across the Basin as shown in Table 6 and Figure 3. Earlier projections indicated that reduced tillage would be most favored economically in the following counties: DeKalb (IN), Crawford (OH), Seneca (OH), Allen (OH), Auglaize (OH), Steuben (IN), Wyandot (OH), and Hancock (OH). Most of these counties have relatively low reduced tillage adoption rates. Similarly, several counties in the glacial lake bed region of northwestern Ohio (e.g., Fulton, Henry, and Ottawa) have relatively high adoption rates even though there are fewer economic advantages to reduced tillage in these areas.

Obviously, the suitability of soils is not the only factor explaining adoption of reduced tillage. Many other socio-economic factors influence adoption rates such as farm size, age and education of the operator, tenure of the farmer, condition of improved drainage systems on the farm, and the attitudes of farmers. The explanatory ability of some of these factors are tested.

Analysis of Adoption Rates of Tillage and other Conservation Practices

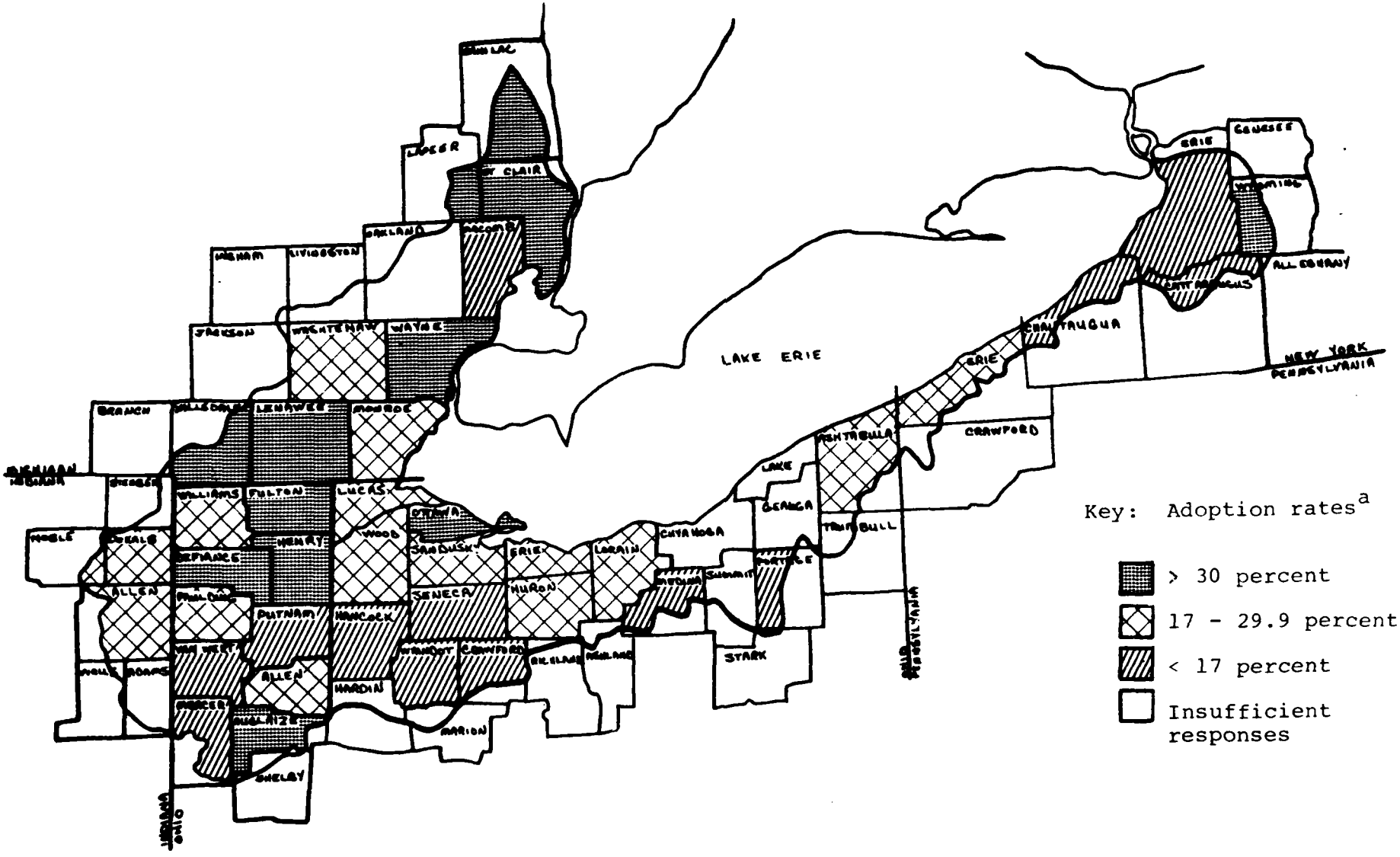
Those farmers returning questionnaires indicated that the fuel and labor savings associated with reduced tillage systems were important considerations in adopting these systems. Hence, the potential net returns from alternative tillage systems are expected to partially explain reduced tillage adoption. Also, the

Table 6. Lake Erie Basin Survey -- Use of Alternative Tillage Practices on Respondents' Row Crop Acreage, by County, 1979

			Conventional Tillage	
	No till	Minimum tillage	Spring Plow	Fall Plow
Monroe, Mi	0.0	24.7	31.5	43.8
Crawford, Oh	0.0	10.0	44.1	45.9
Seneca, Oh	1.4	12.1	61.3	25.2
Huron, Oh	0.0	20.9	38.0	41.0
Ottawa, Oh	6.0	30.2	15.6	48.2
Sandusky, Oh	0.0	25.2	38.1	36.7
Erie, Oh	0.4	19.4	50.4	29.7
Wood, Oh	0.7	21.4	10.3	67.6
Lucas, Oh	0.5	29.1	29.2	41.3
Hancock, Oh	0.0	9.5	14.3	76.2
Wyandot, Oh	0.0	11.1	36.8	52.1
Hardin, Oh[a]				
Marion, Oh[a]				
Richland, Oh[a]				
Henry, Oh	0.0	32.9	14.4	52.6
Ashland, Oh[a]				
Medina, Oh	0.0	7.1	73.4	19.5
Cuyahoga, Oh[a]				
Summit, Oh[a]				
Lake, Oh[a]				
Geauga, Oh[a]				
Portage, Oh	0.0	14.3	85.7	0.0
Stark, Oh[a]				
Ashtabula, Oh	0.0	20.0	74.6	5.4
Trumbull, Oh[a]				
Erie, Pa	0.0	23.6	60.2	16.2
Crawford, Pa[a]				
Chautauqua, N.Y.	16.7	0.0	83.3	0.0
Erie, N.Y.	0.0	5.5	89.1	5.4
Cattaraugus, N.Y.	0.0	10.3	78.6	11.1
Wyoming, N.Y.	0.0	32.1	45.7	22.2
Sanilac, Mi	0.0	53.5	21.1	25.4
Lapeer, Mi	0.0	65.7	17.6	16.7
St. Clair, Mi	0.0	25.2	24.6	50.2
Ingham, Mi[a]				
Livingston, Mi[a]				
Oakland, Mi[a]				
McComb, Mi	0.0	2.3	51.2	46.5
Jackson, Mi[a]				
Washtenaw, Mi	5.5	18.7	63.7	12.1
Wayne, Mi	0.0	34.9	63.0	2.1
Hillsdale, Mi	4.4	33.2	59.2	3.2
Lenawee, Mi	2.0	38.9	34.4	24.7
Steuben, In[a]				
Williams, Oh	0.0	17.0	27.8	55.2
Fulton, Oh	0.0	36.8	34.1	29.1
Noble, In	0.0	28.9	31.7	39.4
DeKalb, In	0.6	25.2	34.9	39.3
Definance, Oh	1.3	29.7	17.9	51.2
Lorain, Oh	7.2	16.3	54.5	22.0
Allen, In	0.0	25.1	15.4	59.5
Paulding, Oh	4.8	24.0	1.5	69.7
Putnam, Oh	2.9	13.9	16.9	66.3
Wells, In[a]				
Adams, In[a]				
Van Wert, Oh	0.2	16.4	5.1	78.3
Allen, Oh	0.1	25.4	30.1	44.4
Mercer, Oh	0.1	14.0	45.6	40.3
Anglaize, Oh	0.9	32.6	34.7	31.8
Shelby, Oh[a]				
Allegheny, N.Y.[a]				
Genessee, N.Y.[a]				
Lake Erie Basin	1.7	21.2	34.6	42.4

[a]Counties with less than five observations are not summarized

Figure 3. Lake Erie Basin Survey - Respondents' Adoption Rate of Reduced Tillage Technologies, by County, 1979.



[a]Adoption rate = $\frac{\text{Minimum tillage + No tillage acreage}}{\text{total row crop acreage}}$

number of row crop acres are thought to be an important factor. Those with larger row crop acres would tend to favor reduced tillage since labor efficiency is improved during the critical planting period. Another factor expected to influence reduced tillage adoption is the need for improved drainage systems. Those farms with improved drainage are more suitable for reduced tillage especially where soils are poorly to somewhat poorly drained in their natural state. Tenure of the farm operator is thought to be another partial explanation for adoption of reduced tillage. Landlords may be more hesitant to have a relatively little used technology employed on their farms; furthermore, tenants may not be as concerned with soil conservation as owner operators. Finally, some personal characteristics of the farmer are thought to be important factors. Age, education, and primary occupation are expected to influence adoption rates.

These hypothesized relationships are tested by statistical analysis of survey data. Those farms with row crop acreage are used in the analysis. The following relationship is estimated by multiple regression:

$$(1)\quad ADOPT = a_o + a_1\ ROW + a_2\ C1 + a_3\ C2 + a_4\ C3 + a_5\ PRENT + a_6\ DRAIN + a_7\ ECON$$

where ADOPT is the proportion of a farmer's row crop acreage on which reduced tillage is used in 1979, ROW is the number of row crop acres; C1 is a dummy variable which has a value of 1

if the respondent's primary occupation is farming, or it has a value of 0 if the primary occupation is something other than farming; C2 and C3 are the farmer's years of education and age, respectively, PRENT is the proportion of tillable acres being rented, DRAIN is the respondent's estimate of the proportion of tillable acres needing additional drainage; and ECON is proportion of acres thought economically unsuitable for reduced tillage in the respondent's county. This final variable is taken from earlier analysis (Forster). Unsuitability for each county is defined as the proportion of soils in soil management groups 3 and 5. These management groups are defined in Triplett, Van Doren, and Bone, and groups 3 and 5 are those soils thought least economically advantageous to reduced tillage.

Other conservation practices, such as grassed waterways, crop rotations, and winter cover crops, are widely used by Basin farmers. Most use one or more of these practices to control soil erosion. It is hypothesized that the number of conservation practices used by a farmer is a function of the number of tillable acres on the farm, the type of soils on the farm, and the age, education, and occupational characteristics of the farmer.

Using multiple regression analysis, the following relationship is tested using data from all farms returning completed questionnaires:

$$(2) \quad CONSERV = b_o + b_1\ ACRES + b_2\ C1 + b_3\ C2 + b_4\ C3 + b_5\ ECON$$

Where CONSERV is the number of conservation practices on the

farm; ACRES is the number of tillage acres; C1, C2 and C3 are occupational, age and education characteristics as defined for equation (1); and ECON is the proportion of soils unsuitable for reduced tillage in the respondent's county. This last variable provides an indication of the quality of the soils within a respondent's county.

Results of the analysis are shown in Table 7. In equation (1), the adoption of reduced tillage practices is not well explained by the variables used in the analysis. A measurement of the variability in adoption rates explained by the independent variables is R^2. An R^2 of .079 indicates that the independent variables generally do not explain a high proportion of the variation seen in reduced tillage adoption. Only two of the independent variables are statistically significant in explaining reduced tillage adoption. Acres of row crops and the farmer's years of education are both significant, and both are positively related to reduced tillage adoption. That is, the larger the row crop acreage and the more years of farmer education, the greater is the adoption of reduced tillage. Other hypothesized relationships between reduced tillage adoption and explanatory variables are not statistically significant. The signs of most of these regression coefficients are as expected -- a primary occupation of farming leads to higher reduced tillage adoption; older age and a larger incidence of renting rather than owning to lower adoption rates of reduced tillage. However, the coefficients of these

Table 7. Regression Results Explaining the Adoption of Reduced Tillage and Other Conservation Practices in the Lake Erie Basin, 1979

(1) ADOPT = -7.374 + 0.020 ROW + 6.783 C1
(-0.52) (3.96)*** (1.41)

+4.492 C2 - 0.083 C3 - 1.479 PRENT
(2.62)*** (-0.57) (-0.22)

+7.840 DRAIN - 0.017 ECON
(1.08) (-0.22)

R^2 = .079, F = 4.74***

(2) CONSERV = 11.884 + 0.0027 ACRES + 4.521 C1
(3.45)*** (2.33)** (3.71)***

+1.001 C2 - 0.103 C2 + 0.068 ECON
(2.11)** (-2.69)*** (2.88)***

R^2 = .060, F = 10.19***

Note: Numbers in parentheses are t-values. Asterisks indicate increasing order of statistical significance: * is 10% level, ** is 5% level, and *** is 1% level. The variable definitions are as follows: ADOPT, the proportion of farmer's row crop acreage on which reduced tillage is used; C1, dummy variable for farmer's primary occupation, 1 = farmer, 0 = nonfarmer; C2, farmer's years of education; C3, age of farmer; PRENT, proportion of tillable acres which are rented; DRAIN, proportion of farmed land needing drainage improvements; ECON, estimated proportion of soils in county unsuitable for reduced tillage; CONSERV, number of conservation practices used on the farm; and ACRES, number of tillage acres farmed.

variables are not significantly different than zero. The regression coefficient relating drainage needs to the adoption rate is unexpectly positive but not significantly different than zero.

Results of the analysis of the adoption of those conservation practices other than reduced tillage are shown in Table 7, equation (2). Again, the independent variables explain only a small amount of the variation in adoption rates, and the R^2 is only .06. However, all coefficients are statistically significant from zero and their signs are as expected. Large tillable acreage, a primary occupation of farming, and more years education result in more conservation practices being used. Age is negatively related to adoption rates, and soil characterisitcs help explain adoption rates.

Reduced Tillage Field Plots and Demonstration Programs in the Basin

Field plots and demonstration programs are currently in progress in 27 counties within the Basin. There are 340 tillage plots on 210 participating farms, and the cropland in these plots total nearly 4,400 acres (Table 8). Both minimum tillage (e.g. chisel plowing) and no till are being demonstrated. Generally, data is collected on yields in each county's program. Also, data is collected on soils, fertility, seed population and variety, and pesticides used.

County demonstration programs are placed into one of three categories: high, medium, or low visibility. Highly visible programs are defined as those with five or more participants and in existence for three or more years. Programs of medium visibility are defined as those with five or more participants

Table 8. Summary of Reduced Tillage Field Plots and Demonstration Programs in the Lake Erie Basin

	States					
	OHIO	MICH	IND	NY	PA	BASIN
County Summary						
Counties in Basin	35	14	6	5	2	62
Counties Responding	31	14	6	5	1	57
Counties with Tillage Plots	16	4	3	3	1	27
County Level Data						
A. Plots	264	4	43	14	15	340
B. Farmers Participating	133	4	40	14	19	210
C. Acres	3676	75	541	33	73	4398
D. Tillage Methods (# counties)						
a. No Till	13	1	1	3	1	19
b. Chisel	9	2	2	1	--	14
c. Ridge	4	--	--	--	--	4
d. Strip Tillage	--	--	1	--	--	1
e. Others	2	--	1	1	--	4
E. Years Experience (Range)	1-10	3-25	3-8	1-10	63	1-63
Plot Data Recorded (# counties)						
A. Soils	13	4	3	3	1	24
B. Fertility	12	4	3	3	1	24
C. Planting Stand	12	4	2	2	1	21
D. Seed Varieties	12	4	3	3	1	23
E. Herbicides	13	4	3	3	1	24
F. Insecticides	14	4	3	1	1	23
G. Rainfall	5	2	1	--	1	9
H. Soil Moisture	--	1	--	--	--	1
I. Yields	15	4	2	2	1	24
J. Economics	9	3	--	1	1	14
K. Other	2	1	--	1	--	4
Crops Planted (# counties)						
A. Corn	12	2	2	2	1	19
B. Soybeans	5	1	3	--	1	10
C. Small Grains	1	--	1	1	--	3
D. Others	2	--	--	1	2	5

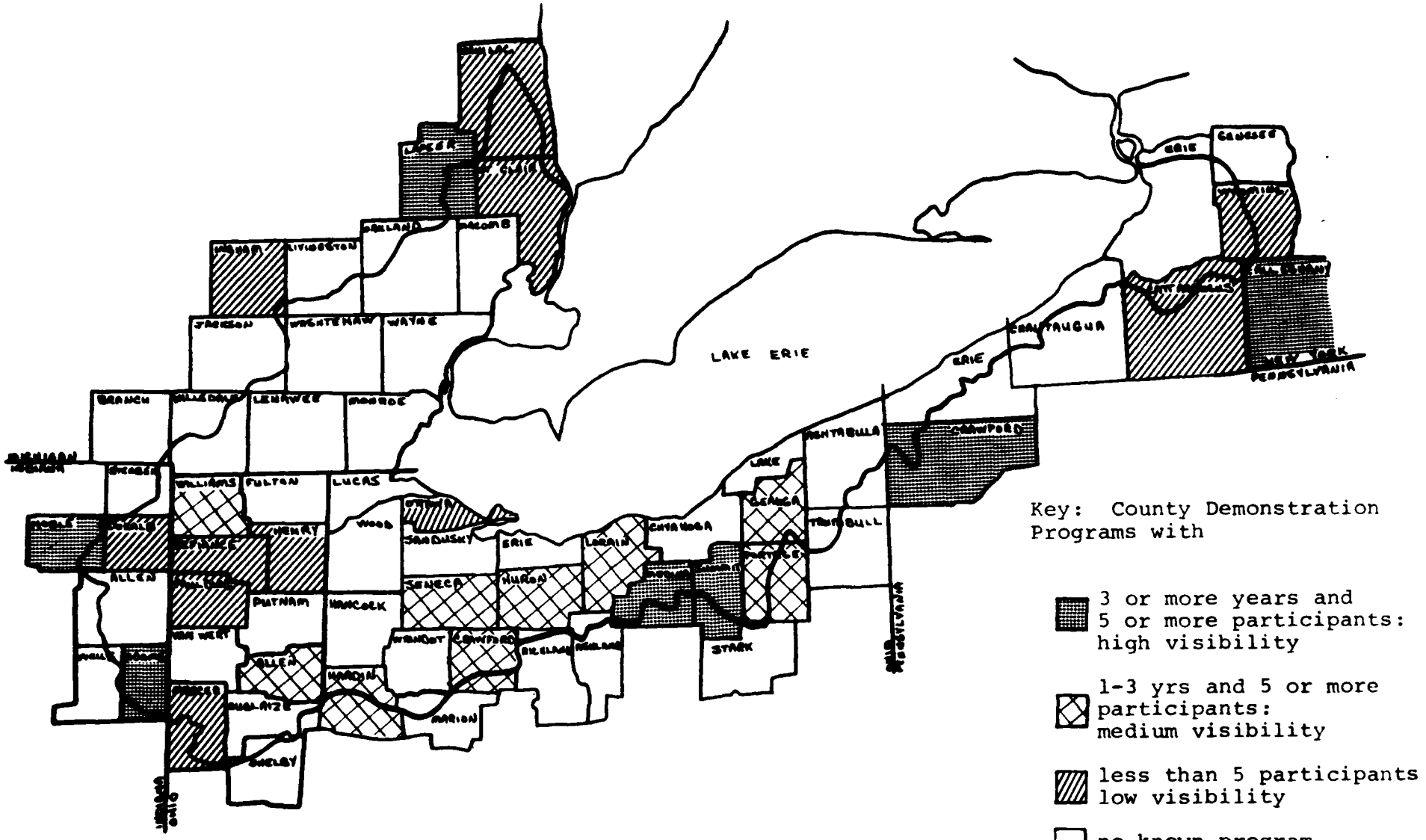
and in existence for less than three years. There are nine counties in the medium visibility category. Low visibility programs are those with less than five participants and in existence for any length of time. There are ten counties with programs having low visibility. Admittedly, these categories are somewhat arbitrary, but they do help sort out the intensity of demonstration program effort.

Comparing county adoption rates (Figure 3) with demonstration program visibility (Figure 4) provides little support for the contention that demonstration programs affect adoption rates. For the most part, the counties with highly visible programs have relatively low reduced tillage adoption rates. For example, many counties with high adoption rates have no demonstration programs (Wayne, MI; Lenawee, MI; Hillsdale, MI; Fulton, OH). Other counties with relatively low adoption rates have demonstration programs with high or medium visibility (Medina, OH; Seneca, OH: Crawford, OH). These results imply that demonstration programs do not quickly change tillage practices.

On the other hand, very few demonstration programs have been in effect long enough to evaluate their success accurately. Most of those counties with relatively visible programs have been in existence three or four years. Only a few (e.g. Noble, IN) have been in existence for more than five years with a substantial number of participants.

Recent evidence from Bone supports the hypothesis that it may take five to ten years or longer for demonstration programs to affect adoption rates. In Bone's research, adoption rates

Figure 4. Lake Erie Basin Demonstration Programs by Level of Visibility



are estimated for all Ohio counties. In Ohio counties, where demonstration programs started in the 1960's and early 1970's (ten to twenty years ago), adoption of no tillage planting far exceeds the state average adoption rate.

Conclusions

Minimum tillage is being used on a substantial amount of row crop acreage in the Lake Erie Basin. Survey participants indicate that on 21 percent of their row crop acres moldboard plowing is being replaced by chisel plowing, disking, field cultivating or other minimum tillage practices. In addition, no tillage is being used on a very small fraction (less than 2 percent) of row crop acres.

Conventional tillage appears to be used on much of the cropland that seems suitable for reduced tillage. Counties where soils are thought especially suitable for reduced tillage have primarily conventional tillage being used. Whether accelerated education and technical assistance programs can speed the reduced tillage adoption process remains to be seen. However, it is apparent that these programs will be promoting farming practices not being used currently to their potential.

Those farms with larger row crop acreage tend to have higher reduced tillage adoption rates. Undoubtedly, improvements in labor efficient promote its use on these larger farms. Also, farmers with more education are more likely to employ reduced tillage.

Grassed waterways, winter cover crops, and crop rotations are those conservation practices well established

on Basin farms. Each of these practices are used on over one-fourth of the Basin's farms. Those practices with limited use include diversions, filter strips, strip cropping, contour farming, and terracing. These conservation practices tend to be more widely used in the eastern part of the Basin where the terrain is rougher and structural practices are effective in controlling erosion.

Several factors are shown to be important in explaining the adoption of those conservation practices other than reduced tillage. In addition to soil resources, these factors include age, education, primary occupation of the farm operator, and tillable acres on the farm.

It appears that demonstration programs have little impact on reduced tillage adoption in the short run. Little impact on reduced tillage adoption rates has occurred in those counties where demonstration programs have been in effect for the past 1 to 4 years. It is likely that it will take 5 to 10 years before special education and technical assistance program effects are felt.

Appendix A

1

Lake Erie Basin
Tillage and Conservation Practices Questionnaire
Ohio Agricultural and Development Center
and The Ohio State University

I. 1. Do you have any of the following equipment?

	Number	Year of Purchase
a. Chisel plow		
b. Moldboard plow		
c. Field cultivator		
d. Disk		
e. No till planter		
f. Offset disk		
g. Ridge planter		
h. Other non conventional tillage equipment		

2. Do you think that water pollution of lakes and streams in your county is (please check)

Very serious ___
Somewhat serious ___
Small problem ___
No problem ___
Don't know ___

3. County and State where most of your farmland is located. _____

4. Do you think that water pollution in Lake Erie is (please check)

Very serious ___
Somewhat serious ___
Small problem ___
No problem ___
Don't know ___

II. Some of the following questions refer to conventional tillage, minimum tillage and no tillage. Conventional tillage uses traditional moldboard plowing. Minimum tillage replaces moldboard plowing with chisel plowing, disking, field cultivating or similar minimum tillage practices. With no tillage, weed control is accomplished with chemicals, and the soil is not tilled. Reduced tillage refers to either minimum tillage or no tillage.

1. Tillable acres: total acres owned and rented

a. acres owned and operated by you _____

b. acres owned but rented to others to operate _____

c. acres rented and operated by you _____

2. In the blanks below indicate the number of acres of corn and soybeans planted in 1979 under each of the tillage systems listed.

a. LAND OWNED AND OPERATED BY YOU

	Reduced Tillage		Conventional Tillage	
	No Till	Minimum Till	Spring Plow	Fall Plow
Corn				
Soybeans				

2

b. LAND OWNED BUT RENTED TO OTHERS

	Reduced Tillage		Conventional Tillage	
	No Till	Minimum Till	Spring Plow	Fall Plow
Corn				
Soybeans				

c. LAND RENTED AND OPERATED BY YOU

	Reduced Tillage		Conventional Tillage	
	No Till	Minimum Till	Spring Plow	Fall Plow
Corn				
Soybeans				

3. If reduced tillage has been used, please indicate the first year it was used: _____.

4. If reduced tillage has been used or it is planned for the future, indicate why. NOTE: Rate each factor according to its importance using the following scale. (Abbreviations: CU = completely unimportant; SU = somewhat unimportant; N = neither important nor unimportant; SI = slightly important; VI = very important.)

a. Reduced labor cost	CU	SU	N	SI	VI
b. Reduced fuel cost	CU	SU	N	SI	VI
c. Reduced equipment cost	CU	SU	N	SI	VI
d. Increased yield	CU	SU	N	SI	VI
e. Reduced water pollution	CU	SU	N	SI	VI
f. Conserve future soil productivity	CU	SU	N	SI	VI
g. Other: _____	CU	SU	N	SI	VI

5. If reduced tillage has not been used and is not planned to be used in the future, indicate why. NOTE: Use the same rating system as in #4 above.

a. Type of soil is not conducive to reduced tillage planting	CU	SU	N	SI	VI
b. Weed control problems	CU	SU	N	SI	VI
c. Poor stands	CU	SU	N	SI	VI
d. Increased labor costs	CU	SU	N	SI	VI
e. Pest control problems	CU	SU	N	SI	VI
f. Increased fuel costs	CU	SU	N	SI	VI
g. Increased equipment costs	CU	SU	N	SI	VI
h. Other: _____	CU	SU	N	SI	VI

6. If reduced tillage has been used, but will not be used in the future, briefly explain why.

_____

In which year did you discontinue its use? _____

7. Please check any of the following conservations practices being used

	Land rented from others	Land rented to others	Land owned & operated
a. grassed waterway			
b. terracing			
c. diversions			
d. strip cropping			
e. drop structures/rock shutes			
f. filter strip			
g. winter cover crop			
h. contour farming			
i. crop rotation using meadow in the rotation:			
Proportion of cropland in meadow rotation	____%	____%	____%
j. crop rotation without meadow in the rotation			
Proportion of cropland in non-meadow rotation	____%	____%	____%

8. What proportion of the tillable acreage that you own has subsurface drainage or improved surface drainage?

0-20% ___ 21-40% ___ 41-60% ___ 61-80% ___ 81-100% ___

9. What proportion of the tillable acreage that you own needs additional subsurface or improved surface drainage?

0-20% ___ 21-40% ___ 41-60% ___ 61-80% ___ 81-100% ___

10. What proportion of the tillable acreage that you rent has subsurface drainage or improved surface drainage

0-20% ___ 21-40% ___ 41-60% ___ 61-80% ___ 81-100% ___

11. What proportion of the tillable acreage that you rent needs additional subsurface or improved surface drainage

0-20% ___ 21-40% ___ 41-60% ___ 61-80% ___ 81-100% ___

III. 1. Now that we have talked quite a bit about tillage and conservation practices, here are a number of topics on which we hope to get your opinions.

(Please use the following coding system: Definitely should be done = 1, Probably should be done = 2; No opinion = 3; Probably should not be done = 4; Definitely should *not* be done = 5.)

a. Reducing air pollution from farms	1	2	3	4	5
b. Reducing water pollution from farms	1	2	3	4	5
c. Preserving family farms	1	2	3	4	5
d. Less governmental regulation of farms concerning pollution	1	2	3	4	5
e. Preserving land for food production	1	2	3	4	5
f. Reduce soil erosion from farms	1	2	3	4	5
g. Use more chemical fertilizers	1	2	3	4	5
h. More governmental control of runoff from cropland and confined livestock facilities	1	2	3	4	5

2. Now we have some background questions, the answers to which will help us interpret the results of this survey.

a. What do you consider your main occupation or job to be? _____

b. Do you have a second job or occupation? No_____ Yes_____
If "yes", what is it? _____

c. How many years have you been associated with farming? _____Years

d. How many years of schooling have you completed? (please check)

some grade school	_____
grade school	_____
some high school	_____
high school graduate	_____
some college	_____
college graduate	_____
other: _____	_____

e. What is your present age? _____ Years

f. What was your father's main job when you were growing up? _____

g. Generally speaking, in politics do you usually consider yourself a

liberal ____ conservative ____ moderate ____

h. Approximately what were the total sales of products produced by your farm business (gross farm income) in 1979?

_____ $ 0 -11,000	_____ $60,001- 80,000
_____ $11,001-20,000	_____ $80,001-100,000
_____ $20,001-40,000	_____ $100,001 and over
_____ $40,001-60,000	

i. Generally, how do other farmers in this community react to a person who is the first to try a new practice?

very positively	_____
positively	_____
unconcerned	_____
somewhat negatively	_____
very negatively	_____

IV. Finally, we have a few attitudinal questions on which we wish to have your opinions.

(Please use the following coding system: Strongly agree = 1; Agree = 2, Undecided = 3; Disagree = 4; Strongly disagree = 5)

1. Agricultural life is the natural life for man.	1	2	3	4	5
2. The farm is the ideal place to raise a family.	1	2	3	4	5
3. Farming is a way of life and not a business.	1	2	3	4	5
4. The family farm is vital to maintaining the American way of life.	1	2	3	4	5
5. Pollution laws have gotten too strict in recent years	1	2	3	4	5
6. Industry should be allowed to handle pollution its own way.	1	2	3	4	5
7. If an industry cannot control its pollution, it should be forced to shut down, even if a large number of people would lose their jobs.	1	2	3	4	5
8. City life is too rushed and formal for me.	1	2	3	4	5
9. Children should spend at least part of their childhood on a farm.	1	2	3	4	5

Appendix B

LAKE ERIE WASTEWATER MANAGEMENT STUDY
SURVEY OF
CONSERVATION TILLAGE ACTIVITIES

County _____

State _____

1. County Level Demonstration Plots and Plantings (1979 only):

   A. No. of Plots _____
   B. No. of Farmer Participants _____
   C. No. of Acres _____
   D. Planting Methods Used: (check)
      a. No Till . . . . . _____
      b. Chisel. . . . . _____
      c. Ridge . . . . . _____
      d. Strip Tillage . . . _____
      e. Others (list) _____
      _____
   E. No. of Years Experience (Demo plots) _____

2. Plot Data Recorded: (check)

   A. Soils . . . . . _____
   B. Fertility . . . . . _____
   C. Planting-stand Info . _____
   D. Seed varieties. . . . _____
   E. Herbicides. . . . . _____
   F. Insecticides. . . . . _____
   G. Rainfall. . . . . _____
   H. Soil moisture . . . . _____
   I. Harvest yields. . . . _____
   J. Economics . . . . . _____
   K. Others (list) _____
   _____

3. Crops Planted: (check)

   A. Corn. . . . . _____
   B. Soybean . . . . . _____
   C. Small grains. . . . _____
   D. Others (list) _____
   _____
   _____

4. Sponsors and Key Contact Persons (please list NAME, AGENCY, ADDRESS, and PHONE - attach a separate sheet if necessary)

Prepared by _____
Date _____

Return to: George L. Stem, SCS/COE
Box 448, Highland Court Street
Medina, OH 44256

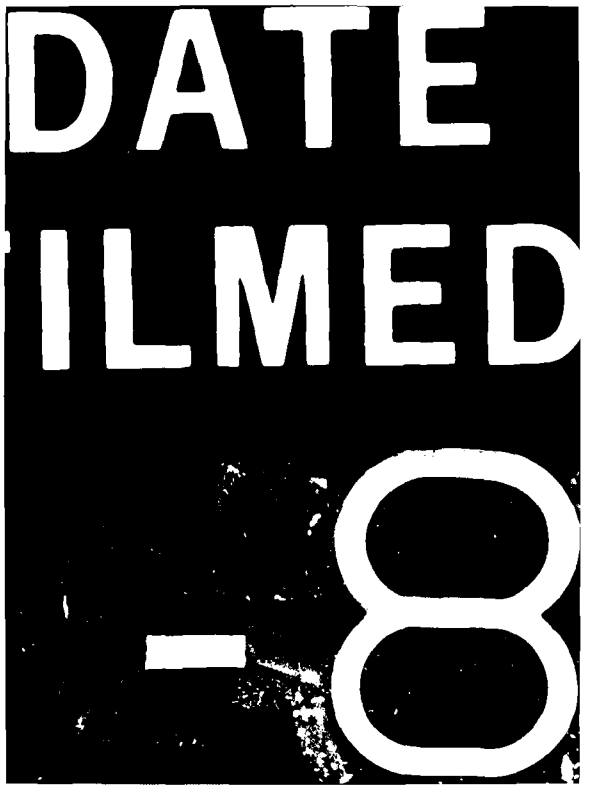
References

Bone, Smauel W., "Tillage Practices and Equipment Used in Corn, Soybean and Forage Production", Bulletin 399, Cooperative Extension Service, The Ohio State University, December 1979.

Forster, D. Lynn, "Economic Impacts of Changing Tillage Practices in the Lake Erie Basin", Technical Report Series, U.S. Army Corps of Engineers, Buffalo, August 1978.

Triplett, G.B. Jr., D.M. Van Doren, Jr., and S.W. Bone, "An Evaluation of Ohio Soils in Relation to No-Tillage Corn Production", Research Bulletin 1068, Ohio Agricultural Research and Development Center, December 1973.

U.S. Army Corps of Engineers, "Lake Erie Wastewater Management Study Methodology Report", Buffalo District, March 1979.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